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ABSTRACT

Cost effectiveness of on-the-job training (OJT) can be determined by measures of effectiveness and by cost assessing the relationship between output and input. Defining effectiveness to be a measure of what an activity produces leaves two main groups of problems unresolved: hierarchies of effectiveness and multiple outcomes. The most significant level in the hierarchy of effectiveness that would permit unambiguous attribution of effectiveness of OJT activity must be determined. At each level OJT may have multiple outcomes, since a trainee is usually certified on a number of tasks or OJT may be a qualification for promotion. Care must be taken to assess attainment of each objective and to judge the relative importance of each. In any cost analysis different categories of cost must be considered. There are three types of OJT activities with varying costs--Type 1, whose only product is training: Type 2, requiring little OJT and producing work: and Type 3, producing both work and training simultaneously with the same resources. OJT trainees may offset some of the OJT cost by participating in Type 2 and 3 activities. To establish the effects of cost on OJT provision, organizations must determine the cost of all three types. (YLB)

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Polly Carpenter-Huffman

PREFACE AND ACKNOWLEDGMENTS

This paper was presented at the Third International Learning Technology Congress and Exposition in Washington D.C. during February 1980, sponsored by the Society for Applied Learning Technology. Several of my Rand colleagues critiqued this paper--Mort Berman, Brent Bradley, Irv Cohen, Ron Hess, and Craig Moore. I am indebted to them for considerably improved clarity and accuracy.

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INTRODUCTION

During the past few years the military services have been concerned about the cost and effectiveness of their On-the-Job Training (OJT) programs. These concerns have arisen from the recognition that in certain types of work situations, most notably those that generate urgent pressures for production, requirements for OJT may conflict with production so that either production is degraded or, more likely, OJT is done poorly, if at all.[1] To cope with such problems, some operating units have formalized OJT by setting up classes and laboratories on site to teach as much of the job as possible in a structured setting (formal OJT). Withdrawal of people and equipment from operating units to conduct this training has raised questions about the relative efficiencies of the conventional and formal approaches. To address problems such as these, the Air Force is directing a large program of OJT research both in- and out of-house.

In many situations, OJT can be the best way to train someone to produce work. First, it can be the most effective way. Since its content and conduct are usually dictated by the needs of the workplace, it is immediately relevant.[2] Moreover, the trainee can be highly motivated to learn because he or she can observe this relevance directly. Finally, the trainer may also be highly motivated to teach because the results of his or her efforts may reduce his or her own workload and may contribute to positive evaluation by his or her supervisor, whereas inadequate teaching may

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[1] See Stephenson and Burkett, 1975, and Carpenter-Huffman, 1979, for discussions of OJT deficiencies and their sources.

[2] The content and conduct of some OJT may not be dictated by the immediate needs of the workplace, however; such training is often neglected, for obvious reasons.

harm both the trainer and the work.

On the other hand, OJT may be ineffective in preparing a person for work that requires high level, cognitive skills. Such skills are best taught in formal, structured settings.

Second, OJT can be more efficient than other training methods because it uses resources that produce work as well as training. In fact, OJT may use resources that have been supplied to meet peak work loads but that would otherwise be idle. As noted earlier, however, if work loads are such that resources are rarely idle, attempts to conduct OJT may interfere with work production.

Before proceeding further, I should make clear what I mean by OJT. The term is sometimes applied to such diverse activities as instruction on specific tasks during work performance and self-study of correspondence courses. I define OJT to be any pre-planned use of work resources (people, equipment, facilities) in the work environment primarily for the purpose of training someone to produce work. By work resources, I mean resources that are usually used in the workplace to produce work. Thus I exclude correspondence courses from the definition. I also exclude formal OJT when it is not conducted in the work environment.

OJT is a particular kind of on-the-job learning, which can occur throughout a person's working life. I do not include in my definition of OJT that on-the-job learning that takes place serendipitously during the production of work but that is not pre-planned. It might be possible to assess the effectiveness of on-the-job learning by measuring the level of productivity a worker attains and to assess its cost by measuring the time

and other resources the worker requires to reach specified levels of productivity.[1]

In this paper I discuss the concepts of effectiveness and cost as applied to OJT. These concepts are key to explorations of policy questions such as: Is an OJT program as productive as it should, or can, be? How can an OJT program be made more useful? Is the OJT program overly costly? Would it be less expensive to provide OJT in some way other than is now being done?

Measures of effectiveness and cost permit assessment of the relationship between what an activity produces (output) and what is required to support that activity (input). That these apparently simple concepts are not straightforward, however, is attested by common errors in their application, some of which I discuss below.

OJT EFFECTIVENESS

Defining effectiveness to be a measure of what an activity produces leaves several problems unresolved. These fall into two main groups, the problem of hierarchies of effectiveness and the problem of multiple outcomes. I discuss the hierarchy problem first.

Hierarchies of Effectiveness

The most proximate output of OJT is the certification that a trainee can perform a set of specific tasks. OJT performance, or efficiency, would be measured by the number of trainees that have been certified to perform a given set of tasks using a particular set of unit resources.

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[1] For research that has addressed some aspects of this concept see Weiher, et al., 1971, Gay and Albrecht, 1978, and Albrecht, 1979.

The number of tasks for which a trainee has been certified is not, however, a measure of OJT effectiveness for that trainee. The primary purpose of OJT is to improve a person's ability to perform work. The assumption is that people who can perform work better will either produce more work or produce work of higher quality or both; alternatively, fewer people will be needed to produce work of the same quality or quantity. Thus, the effectiveness of OJT, that is its effects on something beyond its most proximate output, should be assessed in terms of the quality or quantity of work produced by people who have had OJT.

Although proximate output and effectiveness may be closely related, the distinction between the two is not trivial. Even though OJT is conducted within the work environment there are always fundamental differences between the OJT process and work.[1] For example, the set of tasks chosen for OJT may be unimportant for the job. Or the OJT trainer may teach the trainee to follow correct procedures that are often bypassed on the job, which may put the trainee and supervisor in conflict in the work situation. Even within the training environment reliable evaluation may be difficult, particularly when tasks requiring high-level cognitive skills (such as troubleshooting) are involved. The common practice of having the OJT trainer or the trainer's supervisor certify the competence of the trainee compounds these difficulties. These are some of the many possible points of difference that argue against limiting assessments of OJT to evaluation of its success in the training environment in teaching the tasks in the OJT syllabus. Any evaluation of OJT effectiveness must, however, include a

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[1] See Goldstein, 1978, for an excellent discussion of these differences.

careful assessment of its proximate output so that sources of OJT strengths and weaknesses may be identified.

To illustrate the pitfalls of confusing proximate output with effectiveness, several evaluators of formal training have asserted that a training procedure that allows students to learn a given body of material in less time than before is more effective,[1] even though the proximate output of training is the same. Student time in training is an input (perhaps the most important single input) to training, not an output of training. Shortened training is merely more efficient training. The conceptual confusion may have helped obscure the real issue, namely, whether the reduced training was as effective in preparing the graduate for the job as was the original training.

Carrying the concept of effectiveness further, we can identify a hierarchy of effectiveness. For example, if OJT is being given to people who maintain aircraft, the first level in the hierarchy of effectiveness would be the amount or quality of aircraft maintenance they produce after training, such as the number of defective aircraft repaired;[2] the second, an assessment of the ability of the aircraft to accomplish the assigned mission, such as the number of successful sorties generated; the third, the ability of the command to which the aircraft are assigned to accomplish its mission, such as the ability to blunt a counterstrike; and so on. Each higher level elevates the significance of the OJT outcome.

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[1] This was the original justification for the Advanced Instructional System, for example.

[2] For purposes of illustration, these examples are simplistic; I elaborate them shortly.

Unfortunately, each higher level also introduces influences on the outcome from sources other than OJT and thus obscures the effects of OJT on the outcome. For example, the rate of production of aircraft inspections may rise in response to an increase in sortie rate, rather than to increased personnel skills. Thus in this case it would be important to evaluate the maintenance process as well as its output to insure that extraneous influences have been considered.

In sum, the first problem in definition is to establish the most significant level in the hierarchy of effectiveness that would permit unambiguous attribution of effectiveness to the OJT activity. Although the exact choice will usually depend on specifics of the OJT activity of interest, every effort should be made to choose a level at least one step above mere OJT output because of the differences between the OJT and work environments.

Multiple Outcomes

At each level in the hierarchy of effectiveness OJT may have multiple outcomes. Multiple outcomes appear even at the level of proximate output, since the trainee is usually certified on a number of tasks, each of which might have a different weight to reflect its importance in the work situation. Weights could include several aspects of importance, such as the frequency with which each task is performed. The Air Force's Occupational Measurement Center has developed techniques for establishing the relative importance for an entire career field of each of a set of tasks;[1] these techniques might be applied at the work center level. Although such a for-

[1] See, for example, Christal, 1975.

mulation permits us to conceptualize the assessment of OJT output, this assessment should also be informed by an analysis of the OJT process for full understanding of its implications.

If we take performance of work on the job for measuring effectiveness, we may want to use a similar weighting scheme to combine measures of different kinds of output. It will usually be possible to group specific outputs into more global products; for example, the separate tasks required to perform a scheduled aircraft inspection could be combined into the number of inspections produced. However, as discussed earlier, the more global the measure, the greater the possibility that activities other than those of concern may affect it.

There is still another way in which multiple outcomes may arise, namely, OJT may have more than one purpose. For example, evidence of successful completion of OJT is often required to qualify the trainee for promotion. In such a case, qualification may become a <u>separate</u> objective for the OJT activity because it generates rewards that are not consequences of work production. If workers must compete for promotion for which qualification is prerequisite, pressures for qualification may degrade the effectiveness of OJT in improving the production of work.

In assessing the effectiveness of OJT programs with multiple, and possibly conflicting, objectives, care must be taken to assess attainment of <u>each</u> objective and to judge, as best one can, the relative importance of each. It is also essential, when making such an assessment, to determine the extent to which multiple objectives conflict. It is certainly <u>not</u>

legitimate to use a single measure, such as the number of people qualified, as the measure of OJT output, as has been done in the past.[1]

COST

Throughout the following discussion, I use cost as a surrogate for the resources required to support OJT (the inputs to the OJT process). Usually analysis of the cost of an activity poses less difficult problems than does analysis of its effectiveness, even though many questions must still be answered. For example, the analyst must decide which resources should be charged to the activity, how dollar costs should be discounted, and how costs should be categorized. In most cases, the choice of analytically sound answers to these questions depends on the policy issues being considered, but procedures for making the proper choices are well established.[2]

For example, decisions about how to make an OJT program more efficient often focus on features of the program that can be manipulated at the local level, such as taking better advantage of training opportunities arising during normal work or improving the teaching skills of OJT trainers. The efficiency of such alternative procedures will hinge on the efficiency of local resource use. Such activities as over-all management of the OJT program at higher headquarters may be little affected, and knowledge of the cost of these activities, of little help in making the choice.

The cost of expanding the program to more people will be an "incremental" cost, that is the cost of training additional people beyond those that the program is already training, and the average cost of training a single additional person, a "marginal" cost. Just as the cost of training

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[1] Eisele, et al., 1979.
[2] See, for example, Fisher, 1970.

a single person must be thought of in the context of the total training activity, it is not possible to determine the cost of teaching a single task in isolation, as some analysts have proposed to do. The cost of teaching a single task is probably best determined by finding the difference between the cost of training when the syllabus includes that task and when it does not.

Comparing the cost and effectiveness of conventional OJT with the cost and effectiveness of radically different ways of delivering training, such as formal OJT at the local level or training in task performance at a formal school, raises many questions. The most obvious have to do with whether such different delivery modes produce the same output. In many cases they may not because of difficulties of maintaining training relevance at a physical and psychological distance from the workplace.

But even if equivalence of output could be assumed, different categories of cost should probably be considered in making cost comparisons. For example, if the formal school has another purpose and will continue to operate whether or not the training in question is given there, the bulk of the school administration and support may not be affected and should not be included in the cost comparison. On the other hand, most of the administration and support activities for formal OJT given at the local level may be chargeable to the formal program.

These kinds of questions must be addressed in any cost analysis. OJT presents special problems, however, which are best illuminated by a discussion of the different ways in which work center activities may be related to trainee needs. The simplest type of activity from the point of view of OJT resource use is the activity whose only product is training. I shall refer to these as Type I activities. An example of such an activity is the

supervisor's production of the OJT plan for new trainees. Type I activities often account for a very small part of the resources involved in the total OJT program.

Another kind of activity requires little or no OJT; I refer to these as Type II activities. Examples are routine cleanup of facilities or carrying equipment to or from the workplace. Persons who have already had work experience elsewhere may be able to perform many or most work activities without OJT.

Type II activities are important because they contribute to the product of the work unit without levying additional resource needs for training. Moreover, the performance of Type II activities by less valuable people, such as apprentices, frees more experienced people to concentrate on more demanding tasks and thereby offsets some of the cost of OJT. In fact, some recent work on the cost of medical education in teaching hospitals suggests that some types of patient care may be provided less expensively in teaching than in non-teaching hospitals because student labor can be substituted for the labor of more costly physicians.[1] Care must be taken, however, that use of trainees for Type II activities does not degrade their OJT.

I refer to activities in which both work and training are produced simultaneously with the same resources as Type III activities. Often most OJT resources are devoted to Type III activities, but in this case it is not possible to identify the cost of producing training separately from the

[1] For a discussion of this and the following issue, see Massell and Williams, 1977.

cost of producing work in any but an arbitrary fashion.[1] Arbitrary allocations shed no light on the cost issue and are often misleading.

Where OJT involves Type III activities, it is not possible to determine the cost of OJT, alone, because work must be produced to produce OJT. It is possible, however, to estimate both the cost of resources strictly attributable to OJT and the cost of producing both work and OJT; both estimates may be needed for making informed decisions. The cost of resources strictly attributable to OJT is the difference between the resources required by units that perform OJT and the resources required by units that produce essentially the same work but do not perform OJT. If this difference is positive, OJT reduces unit work productivity. The cost of producing both OJT and work is the cost of only those work activities required for OJT.

Since the OJT trainee may offset some of the cost of OJT by participating in Type II activities (which may produce work at reduced cost) as well as by participating in the production of work while being trained in Type III activities, to establish the effects on cost of provision of OJT, determination of the cost of all three types of activities may be required.

SUMMARY

The foregoing discussion makes clear that establishing the effectiveness and cost of OJT can be a demanding task. To assess OJT effectiveness, it is not sufficient to count up the number of trainees upgraded or certified, because of differences between OJT and work. The effectiveness of

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[1] For a discussion of this point, see Koehler and Slighton, June 1973, p. 540.

OJT should be evaluated at least at the level of trainee's production of work. To assess the cost of OJT, it is not sufficient to count up the resources that are, by some means, attributed solely to OJT, because of the interactions between OJT and production. The cost of OJT must be assessed within the context of all work production that may be affected by OJT, either negatively or positively.

OJT is a pervasive activity in many work situations. In some, it may be the best way to prepare workers for their jobs; in others, different approaches may be more desirable. At present, our understanding of how to identify these situations is hampered by our ignorance of either the effectiveness or the cost of OJT. The increasing importance of skilled persons in today's military services argues that improving our ability to identify the best ways to go about OJT may be worth the effort.

This is not an impossible task, but it will require sizeable investments of time, skill, and thoughtfulness. A logical first step is to construct a general model of OJT and to test its adequacy in describing specific situations.

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